Reflectivity Measurements of Layering Spheres For Cryogenically Frozen ICF Targets

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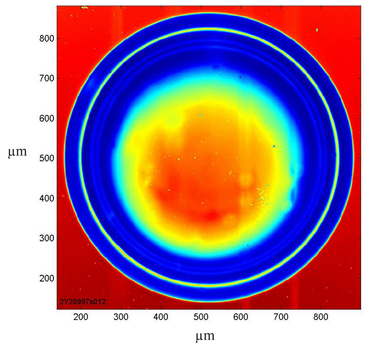
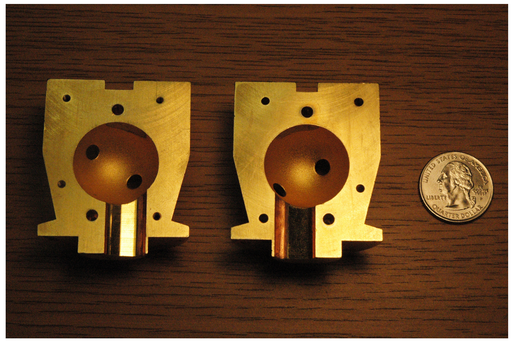
Objective

A process for measuring the reflectivity of a layering sphere has been developed. Cryogenically frozen DT targets are used in Inertial Confinement Fusion (ICF) implosions at the Laboratory for Laser energetics.

An image of a cryo-target with a diameter of 860 μm and an ice layer of 100 μm is shown on the right.



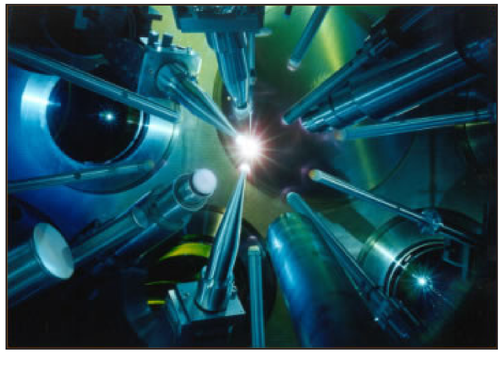
To improve the uniformity of the ice layer, the DT target is placed in the center of a spherical cavity called a layering sphere and is illuminated with infrared light, promoting ice sublimation.



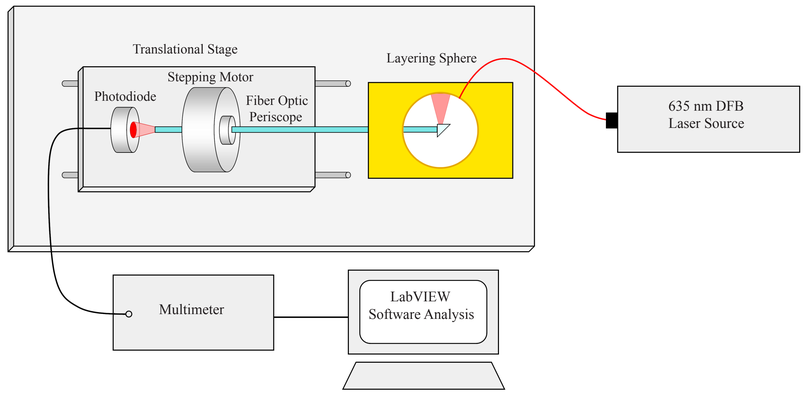
The inner walls of the layering sphere are covered with a rough gold coating to produce Lambertian scattering. There are various windows that can be covered with flanges.

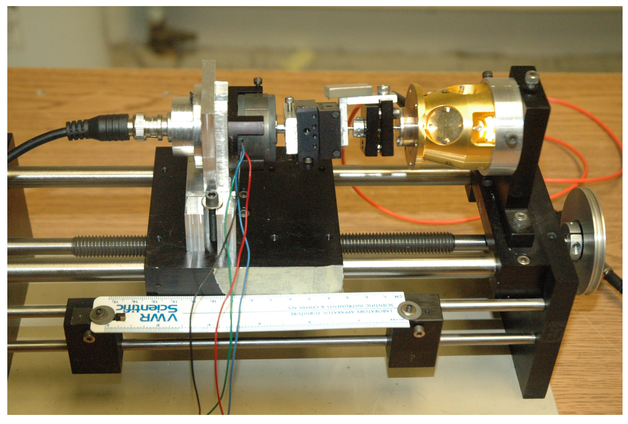
Inertial Confinement Fusion

A target filled with deuterium and tritium is uniformly irradiated with intense laser light, inducing an implosion that initiates nuclear fusion. The target chamber can be seen below.

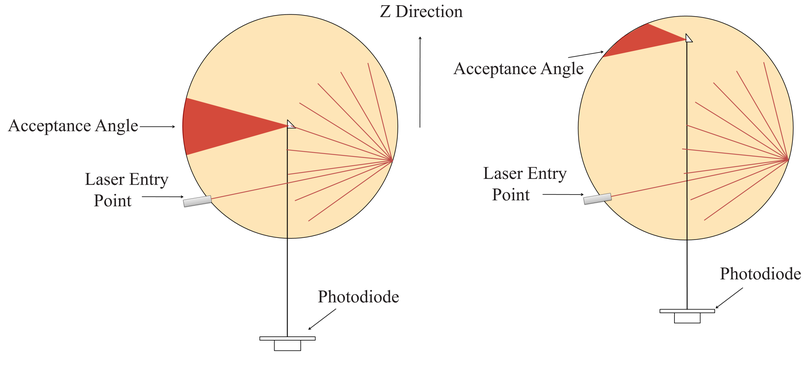


Reflectivity Measurements



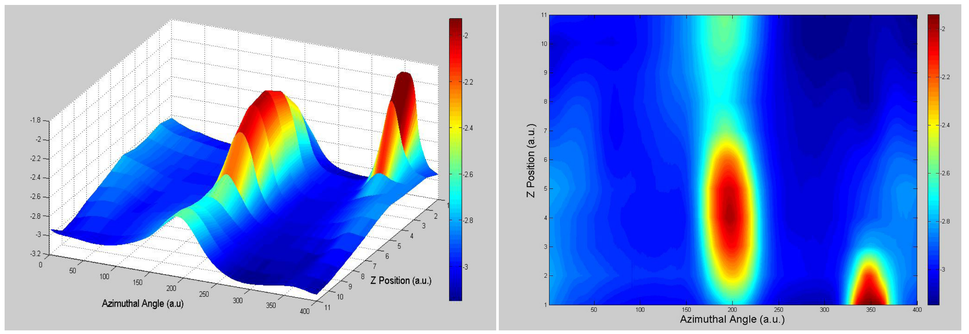


Laser light of wavelength 635 nm is directed into the spherical cavity from a DFB laser source. Reflected light enters a small prism at the end of a fiber optic periscope and is measured by a photodiode at each position. The periscope is rotated in 0.9 deg increments using a stepping motor and Labview software to obtain data for one complete revolution. The periscope is translated in the *z* direction in 1 mm increments to record data sets for 20 *z* positions.

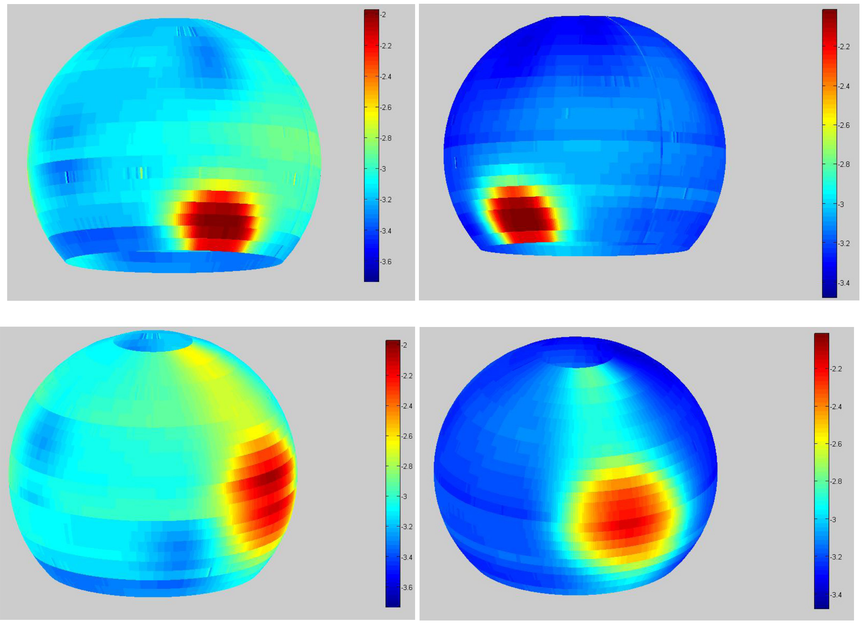


Results

Preliminary results are plotted as *z* position vs. angle with color representing intensity (arbitrary units). The laser entry and initial bright spot are clearly evident.



3 dimensional representation of signal intensity. The data on the left was taken with the windows removed. The images below are the same data viewed from the opposite side. The top two images display the laser entry point while the lower two show the initial bright spot.



Looking Ahead

The laser entry point and initial bright spot dominate the intensity data. The large acceptance angle of the prism (20 deg) limits our precision. In the future a diffuser will be used on the laser as it enters the sphere to expand the initial light distribution.

Funded by the US Department of Energy